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ABSTRACT

Educational software simulations provide a powerful tool for educators, offering an opportunity for learners to experience situations that are otherwise unavailable because they are too dangerous, too expensive, too long in duration, or removed from the learner in time and/or space. In a similar way, the Web offers an even greater audience the opportunity to be involved in a range of scientific experiences particularly in the areas of geology and biology. A number of virtual experiences have been investigated and have been grouped into three categories: virtual field trips; virtual digs; and field trips incorporating virtual reality. (Contains 13 references.) (Author)

Virtual Experiences and the NSW Stage 6 Science syllabuses

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Abstract

Educational software simulations provide a powerful tool for educators, offering an opportunity for learners to experience situations that are otherwise unavailable because they are too dangerous, too expensive, too long in duration, or removed from the learner in time and/or space. In a similar way, the Web offers an even greater audience the opportunity to be involved in a range of scientific experiences particularly in the areas of geology and biology. A number of virtual experiences have been investigated and have been grouped into three categories: virtual field trips; virtual digs; and field trips incorporating virtual reality.

Wood (1997) defines a "virtual field course" as "a (computer-based) resource that meets some of the aims and objectives of a real field course". He offers an alternate definition as "a teaching resource that uses the metaphor of the 'field course' to meet its own educational aims and objectives".

A number of virtual experiences have been investigated and have been grouped into three categories: virtual field trips; virtual digs; and field trips incorporating virtual reality. The following are examples of "best practice' or ones offering potential, found by the authors during a comprehensive web search and will provide models for the development of virtual experiences for the new NSW science syllabuses.

Virtual Field Trips

Field trips and excursions are vital to the study of sciences and the first hand investigation in 'the field' is, and will always be, the ideal educational experience. However, virtual field trips have been developed and are proving successful in a number of unique situations.

> Of course, virtual field trips have many disadvantages compared to the real thing. Perhaps the most obvious and most serious is that the material presented on a computer is only an abstraction of the real thing. This means that just as viewing a photograph does not give the sense of being in the scene that that photograph shows, being on a virtual field trip does not have the same impact as a real field trip. .... They do not and cannot convey the true three-dimensional nature of the location or object, nor convey the touch-texture, smell or a myriad of other subtle clues that aid us to interpret information in the field. This is a general feature of computers, they present a simplifed version of real things. (Hurst, 1998)

Virtual field trips might be the only alternative in certain instances. Traditionally, road and railway cuttings have provided an excellent opportunity for experiencing field science especially geology and soil development. With the development of motorways, it is no longer practical to take a group of students, especially during normal school hours, to observe these sites. Also, as safety becomes more of an issue the geology is often obscured by protective materials put in place to avoid falling rocks and soil slippage. With time, once

excellent examples of geology or ecology might be lost due to regrowth of vegetation. Similarly examples of environmental problems might be lost due to remediation.

In addition, the possibility of field work might be temporarily reduced. A phenomenon that has severely restricted the possibility of actual field work in certain areas has been the outbreak of contagious diseases. The recent outbreak of Foot and Mouth Disease in England, has restricted field work within the United Kingdom to the rest of Europe.

The virtual field trip, *Towra Point Mangrove Excursion*, has been developed by the School of Biological Sciences at The University of Sydney. Traditionally, students undertaking a second year course in Plant Anatomy and Physiology visited the Towra Point site. The intrusion of a large number of people into what is a fragile ecosystem could in fact damage the area. After undertaking the virtual field trip, students are expected to have first hand experience while visiting one of the many mangrove areas around Sydney thereby lessening the potential damage on any one site. It also lessens the administration work load and costs in organising a large excursion and puts the learner in control of their own learning experience. This virtual field trip includes a large number of photographs, graphs and diagrams to support the learning experience and is available either on CD-ROM or via the Web at http://bugs.bio.usyd.edu.au/Mangroves/html/home1.html.

Minnamurra Rainforest Ecosystem Field trip is an excellent example of how the Web can be used to extend and enrich student learning. It is well designed with excellent navigation. It is clearly stated that this virtual experience cannot replace the mandatory field experience that is part of the Geography syllabus. The "aim of this 'Virtual Field trip' is not to replace ordinary fieldwork but to allow students and teachers the opportunity to explore another environment for comparison" with their own area of investigation. The field trip follows a walk through the rainforest. At each stop, thumb-nail photographs, background information, statistics and diagrams are provided, while fieldwork activities and study questions are used to direct the students' observations and learning activities. The thumb-nail images can be enlarged, if necessary, to show details of the vegetation. This virtual field trip can be found at http://hsc.csu.edu.au/geography/ecosystems/case_studies/mmfweb/

Virtual Field Excursions have been implemented by Cliff Ford at the University of Edinburgh within First Year Geology. The concept of *Virtual Field Excursions* arose not as a replacement to actual field trips but in order to overcome some perceived problems in the organisation of actual field trips (e.g. large student numbers, increasing costs, inclement weather and variability in experience and knowledge of field demonstrators). Three excursions have been developed (*Holyrood Park*, *Siccar Point* and *Pease Bay to Cove*) which consist essentially of a sequence of photographs illustrating the geological features to be examined on the actual excursion together with panoramas to locate the features, geological maps and the geological history of the area. One of the excursions includes an on-line quiz. These virtual field excursions are available at http://www.glg.ed.ac.uk/courses/field/

Patrice Rey (2000) has used virtual field trips to "maximise the learning experience". He uses his virtual field trip to the Granites at Wilsons Promontory (Victoria, Australia) "to provide students with the opportunity to 'virtually' go back to the field and have a second look". When preparing course materials, the tendency is to use illustrations which are perfect examples of features or specimens. Actual observations are often less easy to understand and interpret and the provision of selected images assists students to consolidate the field experience.

The virtual geoscience professor, Dr John Butler from the University of Houston, incorporates virtual field trips wherever possible in his physical geology course (http://www.uh.edu/~jbutler/physical/onlinefall2001.html). These 'trips' are to locations that illustrate the concepts being studied that would not otherwise be available to the students. However appearing on most pages is the underlying sentiment of most geology

educators: "Learning about geology from a computer screen is only half as fun as enjoying it in the field!".

Virtual digs

Ideally, students should have access to first hand experiences by visiting locations to fulfil the following requirements of the Earth and Environmental Science syllabus, to:

1. gather information from secondary sources to compare the diversity and number of organisms from a fossil site;
2. identify data and gather first-hand information or information from secondary sources to examine at least one example of a stratigraphic sequence and describe any fossils found in the sequence; and
3. choose resources, gather information from secondary sources and use available evidence, . . . To examine the changes in life forms that occurred during what is commonly referred to as the 'Cambrian event'.

Virtual digs involve the presentation of collections of material (e.g. fossils, plants or artifacts) via the Web that would not otherwise be available to the learner. This can in some way provide resources that might satisfy the requirements listed above.

The Burgess Shale Fossil bed is an exceptional fossil locality dated at about 540 million years ago (Middle Cambrian) in British Columbia, Canada. 'The locality is special because of the soft-bodied preservation of a wide diversity of fossil invertebrate animals.' The web-based resource, *Burgess Shale fossils* (http://www.geo.ucalgary.ca/~macrae/Burgess_Shale/) provides students with an opportunity to view fossils (with brief descriptions) from this geologically significant site. Similarly the Mazon Creek fossil site dating from about 300 million years ago and therefore with a greater diversity in flora and fauna provides a useful resource for students. *Mazon Creek Fossils* can be found at http://www.museum.state.il.us/exhibits/mazon_creek/.

The *Vegetation of Mt Field National Park and the South-West Tasmania Wilderness Area* (http://www.utas.edu.au/docs/plant_science/field_botany/) is used to supplement a field experience. The web site provides students with a comprehensive "description of the flora and vegetation types, combined with key references to the relevant literature" which can be viewed from anywhere in the world.

VIRTUAL DIG: A simulated Archaeological Excavation of a Middle Paleolithic Site in France is a highly developed virtual experience on CD-ROM with an accompanying text. This planning and research exercise allows students to carry out an archaeological dig using real data, supported by maps, plans, graphs and charts, and an on-line database for the identification of artifacts.

Field trips incorporating virtual reality

Virtual reality has been defined as "a state produced in a person's mind that can, to varying degrees, occupy the person's awareness in a way similar to that of real environments." (Macpherson & Keppel, 1998) It "is being touted as a revolutionary and easy way to stroll through worlds that are too far away, too small, too experimental, or too dangerous for ordinary access". (Stevens, 1995)

One such project is the *Virtual Human* – a three-dimensional model of the human body developed by Johns Hopkins University using magnetic resonance (MR), computer tomography (CT), and anatomical sectioning. The viewing experience is enhanced by the use of 3-D glasses as viewers move through blood vessels, watch joints move, and see the heart beat.

At its most sophisticated, virtual reality is expensive to produce and to implement with necessary hardware such as head mounted devices, gloves and motion sensors.

However lower levels of virtual reality are available through programs such as *QuickTime VR Authoring Studio* and *VR Worx* which allow the generation of interactive panoramic movies which can be distributed via the Web.

Effective use of virtual reality can also be employed to enhance the learning experience of a virtual field trip. It has been used very effectively in making available sites of historical importance to a wider audience. The *Corinth Computer Project* allows anyone to experience a visit to the forum in the Roman colony at Corinth through the web site at http://corinth.sas.upenn.edu/corinth.html. A similar project, *Virtual Palenque* (http://www.virtualpalenque.com/) is a guided virtual tour with amazing panoramic views (virtual reality movies) of the Mayan ruins at Palenque.

Virtual Field Trip to the summit area of the Tongariro Volcano, New Zealand is a series of three panoramic movies produced using *QuickTime VR* produced by the Department of Earth Sciences at La Trobe University. They provide Australian students with a 'virtual' visit to a live volcano in order to observe landforms and landscapes associated with it. (http://www.geology.latrobe.edu.au/ESWeb_Site/TongariroQTVR.html)

The Open University has made excellent use of virtual reality in the construction of 'A geological field trip' which is part of Topics in Biology and Geology in the Discovering Science series of CD-ROMs. The main purpose of the field trips is not to replace the field trip but to instruct students in how to carry out a field investigation.

There continues to be resistance to virtual field experiences. Wood (1997) suggested this is due to the fact that they are "often seen as replacement" and "can be a threat to established practices". He emphasises that virtual field trips must use the virtual technologies to "extend and enhance rather than replace".

The virtual experiences that are currently under development by UniServe Science in collaboration with a number of interested groups include panoramic movies of geological landscapes in and around Sydney, a virtual field trip to an area affected by salinity, fossil locations to investigate diversity and abundance, and a sample "local environment" investigation.

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